Farming a CHANGING SEA

STRUGGLE AND SUCCESS IN ATLANTIC CANADA, WHERE AQUACULTURISTS STRIVE TO OVERCOME CLIMATE CHANGE AND CONTAMINATION WHILE CHASING A SUSTAINABLE CARBON FOOTPRINT

BY **KAREN PINCHIN** WITH PHOTOGRAPHY BY **MATT HORSEMAN**

IN THE DAYS BEFORE Hurricane Fiona hit Atlantic Canada last September, oyster farmers Hana Nelson and Philip Docker carefully secured equipment, boats and patio furniture — anything that could turn into a projectile. They sank hundreds of floating plastic mesh oyster cages, each containing hundreds to thousands of baby oysters, below the reach of high winds and choppy waves. But as the storm made landfall about two hours north of Halifax on Big Island, N.S., their home felt the sheer force of Fiona as it rattled around them and their two young daughters. All they could do was wait — and hope.

The next morning, the sun rose weakly into a grey sky and winds still blew upwards of 100 km/h as they surveyed the worst of the damage.

The often-**REMOTE COASTLINES** they call home are perched on a **perilous edge**, buffeted by increasingly powerful storms and pinched by an **AGING WORKFORCE**.

On a beach alongside one of their oceanfront lease sites, a wooden building dubbed the "Shuck Shack" lay splintered across the sand. Surging waters had wrenched a local wharf completely off its moorings, leaving a gaping chasm. At the other end of their bay, near their larger 20-hectare site, so much sand had eroded off a local spit they suspect it will soon disappear. "There used to be a lobster processing factory on that spit," says Nelson, gesturing towards the slice of land, once wide enough to hold a building but now mere steps from end to end, its factory long gone. "See now how tiny it is." By this time next year, Docker speculates, rising waters will consume the rocky bar, a fallout that could fundamentally change their oysters' ecosystem. "We'll have seen a change in my generation to this harvest system," he says. "All the [wild] clams and everything else that lives there, that won't exist anymore."

Nelson and Docker's farm, ShanDaph Oysters, is one of hundreds of aquaculture businesses dotted across Canada's sprawling east coast. On rusting boats, creaking docks and bubbling hatcheries across Atlantic Canada, the entrepreneurs working in and alongside the ocean are grappling with what it means to farm a landscape in the throes of overlapping crises. Their farms collectively employ thousands of workers who grow and harvest species including oysters, mussels, Atlantic salmon and seaweeds. They sold nearly half a billion dollars of seafood into a hungry global market in 2021 alone. Yet the often-remote coastlines they call home are perched on a perilous edge, buffeted by increasingly powerful storms and pinched by an aging workforce. And whether or not they succeed will determine the future of this region and the seafood Canadians consume.

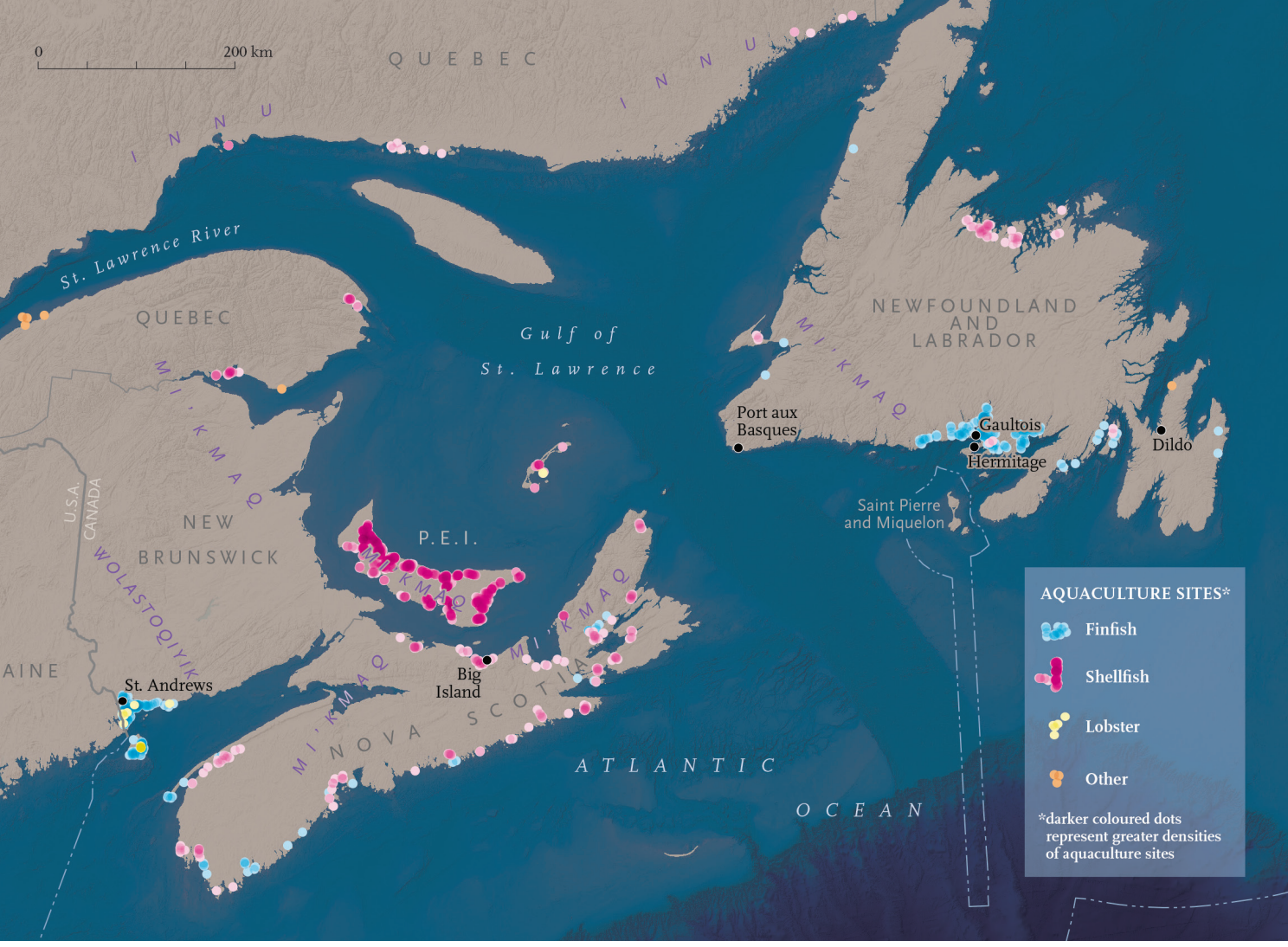
In 1971, French oceanographer Jacques Cousteau stated: "We must plant the sea and herd its animals using the sea as farmers instead of hunters. That is what civilization is all about — farming replacing hunting." For Cyr Couturier, an aquaculture scientist and chair of the MSc sustainable aquaculture program at Memorial University of Newfoundland, those decades-old words still feel like a summons. At the time, when he was a high school student, Couturier belonged to Cousteau's youth club — a membership bought with a few cereal boxtops — and the idea stuck with him. "It clicked," he said, and inspired his lifelong career in aquaculture. "Young people, diverse people, growing sustainable food for themselves, their families and for the planet — that's the bottom line."

Since Cousteau's era, academics and policy-makers have heralded farmed seafood, or aquaculture products, as the future of how we will feed our planet's burgeoning population. Demand for seafood production is expected to double by 2050, and Canada has, by far, the longest coastline in the world. Yet the country lags behind many other nations in developing its sector, says Couturier. Two decades ago, it was in the top 10 countries for aquaculture production, but as industry growth stagnated, Canada slipped down the list, landing it at number 25. Today, less than one per cent of the country's suitable aquaculture habitat is used for commercial fish and shellfish farming, a disadvantage Couturier hopes a new generation of aquaculture entrepreneurs like Docker and Nelson can make up while also keeping the social, environmental and economic pillars of sustainability in mind.

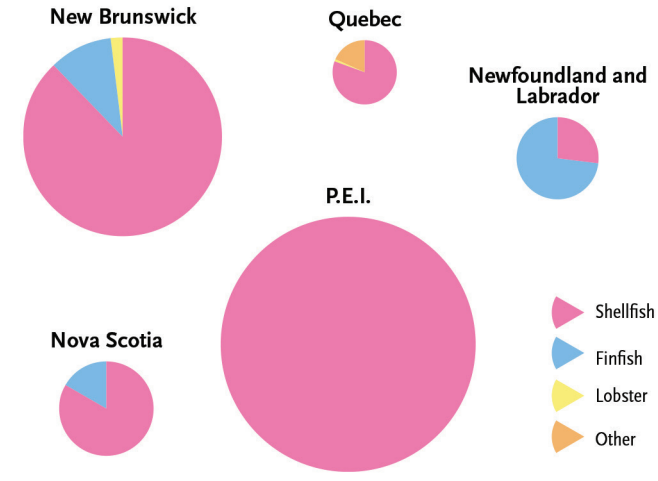
Part of the challenge is the industry's reliance on a small number of species. While more than 70 marine creatures can be legally grown and harvested in Atlantic Canadian waters, one fish — farmed Atlantic salmon — makes up around 80 per cent of the industry's total value. Newfoundland and Labrador's two

PREVIOUS PAGE: Salmon pens at Cooke Aquaculture's Robin Hood Cove site, near Hermitage, N.L.; THIS PAGE FROM TOP: Philip Docker rows his family – Hana, Daphne, 5, and Naia, 20 months – to the ShanDaph barge; Docker and Nelson stand on a spit of land in Merigomish Harbour. Before Hurricane Fiona, the sand dunes that existed where they stand would have covered them completely; Docker shucks an oyster on the ShanDaph barge.

Karen Pinchin (@karenpinchin) lives in Halifax. Her first book, Kings of Their Own Ocean, *will be published in July. Photographer Matt Horseman (@matt_horseman) has had work published in* National Geographic *and* The Globe and Mail, *among others.*



NUMBER OF AQUACULTURE LEASES BY PROVINCE



largest salmon producers, New Brunswick's Cooke Aquaculture and Norway's Mowi, harvested 7,000 tonnes of the fish in 2020 — a weight equal to that of the Eiffel Tower's metal frame. And that volume may just be the start: one provincial report estimated farmed salmon production could increase sevenfold to 50,000 tonnes by 2024.

Before Canadian seafood farmers can rise to the challenge of growing ocean crops in Canadian waters, they must first confront a mercurial sea. Climate change is altering the coastal landscape, with rising seas and intense storms forcing farmers to adapt quickly if their businesses are to survive. Beneath these waves, beyond human attention, turning a profit has historically come at the expense of the ocean's finely tuned ecosystems. Red flags, for both scientists and environmentalists, include farmed salmon die-offs caused by oxygen deprivation, diseases caused by often unnaturally tightly packed holding pens, escaped fish that breed with and dilute the genetics of wild populations, and uneaten fish feed and fecal matter that drift to the ocean floor. Above or below sea, striking a balance that serves both humans and the creatures they farm can be an uncomfortable negotiation on an increasingly precipitous stage.

Salmon tanks at the Cooke Aquaculture hatchery in Swanger Cove, N.L., near St. Alban's.

FISH FARMING has a millennia-long history in Atlantic Canada. It first started with Indigenous stewardship and management practices that shaped this rocky landscape, as First Nations carefully managed oyster beds alongside herring and eel weirs. Post-colonization, Newfoundlanders began experimenting with aquaculture in the late 1880s when the seemingly endless cod stocks began to slump due to rampant overfishing. The then-colony hired a Norwegian fisheries expert, Adolph Nielsen, to oversee a new cod hatchery in the town of Dildo, where cod eggs were collected, hatched and released. That operation closed within a decade, but it wouldn't be the last time governments tried to kick-start the industry.

In the early 1970s, federal research scientists working for the Department of Fisheries and Oceans experimented with Atlantic salmon off the coast of Cape Breton, until cold winter waters — and a phenomenon known as "superchill" — wiped out the project. "It ended in disaster when all fish were lost, some literally from storm-caused cage break up, the rest from lethally low temperatures," John Anderson, a marine biologist and former University of New Brunswick president, wrote in *The Salmon Connection*, a 2007 book about the industry. The experimenters eventually concluded it wasn't "economically feasible to commercially grow salmonids in Nova Scotia's coastal waters." (The problem later turned out to be nets that held the fish too shallowly to the surface, not allowing the fish to swim as deep as needed to escape the killing cold.)

Yet there was too much money to be made and too much nutrient-rich ocean for Atlantic entrepreneurs to give up, and they soon started using technology and practices developed around the world. In the decades since Cousteau's famous declaration, Atlantic aquaculturists have experimented with all manner of edible species — oysters, scallops, mussels, trout and sea plants, including Irish moss — drawing on expertise from government scientists and universities eager to collaborate in exchange for federal dollars.

When one early land-based salmon-farming project east of Halifax went bankrupt in 1972, the Atlantic Salmon Federation, a science and advocacy group committed to boosting numbers of wild salmon in Atlantic waters, bought the company's old equipment and started its own experimental hatchery near Saint Andrews, N.B. The province's earliest salmon-farming entrepreneurs bought baby salmon, or smolt, from this hatchery and another operated by the federal Department of Fisheries and Oceans, raising the tiny fish to glossy, arm-length adult fish in square wooden cages attached to poles pounded into the sea floor and later moving onto octagonal wooden cages affixed by steel brackets. It was dirty, hard work, and over the next decade those farmers learned from their failures and refined their systems. Still, for many, simply breaking even at the end of the year could feel like a win.

This was the moment when one New Brunswick family took its first steps towards building a company that would grow into a multinational seafood enterprise. In 1985, former herring worker Gifford Cooke and his two sons won a government

MAPS: CHRIS BRACKLEY. DATA: QUEBEC: MINISTÈRE DE L'AGRICULTURE, DES PÊCHERIES ET DE L'ALIMENTATION DU QUÉBEC, 2017; NB: MARINE AQUACULTURE SITE MAPPING PROGRAM (MASMP), OPEN GOVERNMENT LICENCE FOR NEW BRUNSWICK, V2; NS: NOVA SCOTIA MARINE AQUACULTURE LEASES, NOVA SCOTIA DEPARTMENT OF FISHERIES AND AQUACULTURE, DECEMBER 22, 2022; PEI: PEI AQUACULTURE LEASED AREAS, DEPARTMENT OF FISHERIES AND OCEANS, CANADA. JULY 19, 2022; NFLD: LICENSED AQUACULTURE SITES AND LICENSED PROCESSORS, NEWFOUNDLAND AND LABRADOR DEPARTMENT OF FISHERIES, FORESTRY AND AGRICULTURE, AUGUST 31, 2021

licence to farm a single pen of 5,000 salmon. At the beginning, operating the small business felt like "throwing money into the water," says Andrew Lively, Cooke Aquaculture's director of public affairs; salmon take about three years to grow to full size while farmers pay for feed, labour and materials. Growing up in Saint Andrews in the 1980s, Lively observed the company's growth firsthand, watching as the Cooke family pioneered owning and running a business at every level of the industry — a practice called "vertical integration." They reinvested money and took out loans, buying first a hatchery and later a fish meal company. For a time, one Cooke son lived beside the hatchery during the frigid depths of Maritime winters to ensure nothing went wrong overnight. Over the next four decades, the family's risks paid off, and Cooke now earns billions in revenue and distributes more than a billion pounds of food worldwide every year.

Yet it wasn't an easy journey, for the company, its communities or its creatures. In 1996, disaster swept the nascent salmon farming industry across the region as infectious salmon anemia, a deadly virus, infected and killed scores of farmed fish. Characterized by pale gills, bulging eyes, raised scales and bleeding patches, the disease forced farms to slaughter millions of Atlantic salmon and caused an estimated $45 million in losses to New Brunswick's industry alone between 1997 and 2003. It also earned salmon farming a controversial reputation and attracted the ire of environmentalists who worried farmed fish would interbreed with struggling wild populations.

It was at this moment that farmed salmon's serious public relations problems, familiar to many Canadians today, first began. And while "industry and the environmentalists have been guilty of oversimplifying complex issues, or overstating the degree of certainty of scientific knowledge," wrote Anderson, "the environmentalists have clearly had the edge in getting the public's attention." It didn't help public perception that the largest companies kept getting larger: in 1990, 43 companies owned 52 aquaculture sites in New Brunswick. By 2006, only 15 companies owned nearly 100 sites. Meanwhile, salmon farmers frequently, publicly and widely dismissed environmentalists' legitimate concerns about fish die-offs, the amount of wild catch used to feed farmed fish, and the damage caused by sprawling sites and gear on local ecosystems — even as the companies collected millions of dollars in aid and compensation from federal and provincial governments.

Further east during the same period, Newfoundland's wild-caught cod fishery had collapsed entirely, with a moratorium enacted in 1992. It was a painful, unsettled time in that province, and the fallout left thousands of fishermen out of work and desperate to feed their families. Throughout the 1990s and 2000s, consecutive waves of infectious salmon anemia led to bankruptcies in its aquaculture industry and sped up the consolidation trend. Cooke took economic gambles on those struggling businesses, expanding beyond New Brunswick, buying up its Newfoundland neighbours' lease sites and equipment, and rehiring seasoned workers, including Craig Rose.

'We must **PLANT THE SEA** and herd its animals using the **sea as farmers** instead of hunters. That is what civilization is all about – **FARMING REPLACING HUNTING**.'

ON A COLD morning last November, Rose gripped the steering wheel of one of Cooke Aquaculture's boats tightly as it skipped across the swelling waters from Hermitage, N.L. towards the tiny outport village of Gaultois. It's a passage Rose has made thousands of times: he grew up in the village and only recently moved to the mainland. For him and hundreds of other Newfoundlanders living on the southern coast of the province, a nearly seven-hour drive from the capital of St. John's, the arrival of aquaculture feels as if it has saved the future of the place they call home.

Bouncing atop the waves, his eyes protected against the glare by wraparound sunglasses, Rose navigated past rocky islands and lush forests to enter Robin Hood Cove. There, seagulls wheeled against an azure sky over the three huge pens below. A nearby roaring waterfall provides fresh water into the cove, turning the salt water brackish. Scientists have long known that young salmon grow better and faster in the diluted water; the species is anadromous, spending its early life in fresh water before migrating out to the ocean

Clockwise from FAR RIGHT: Shells on the shore of Big Island, N.S.; aquaculture research technologist Rachel Artuso with a rainbow trout hoisted from one of Memorial University's aquaculture tanks; Peter Tyedmers surveys the damage wrought by Hurricane Fiona on Big Island's only wharf.

and later returning to the waters of its birth to spawn.

Out on Cooke's salmon pens, employee Jeff Herritt watched around 50,000 salmon swim in circles within three deep chambers, each held to the ocean floor by a massive concrete block. Employees like Herritt, who work daylight to dark aboard an anchored barge, constantly monitor the fish, keeping an eye on everything from fish behaviour to water temperature using either the barge's onboard systems or a synced smartphone app. With the click of a mouse, Herritt fed the salmon as hard fish pellets ricocheted from an oscillating tube atop the pens. "Aquaculture is such a blessing to have in this area. If we didn't, a lot of families would just have to move away," he says. "There's not many houses involved with this now that don't have two vehicles in the driveway. Before, you were lucky to have one."

As Newfoundland's cod moratorium enters its fourth decade, the stability promised by a thriving aquaculture sector feels like a lifeline for many others. "If this industry wasn't here, I don't know what I'd be doing," says Sheldon George, president of the Newfoundland Aquaculture Industry Association and Cooke's regional manager in Newfoundland.

Hermitage-Sandyville Mayor Steve Crewe, whose once-struggling community abuts the Robin Hood Cove operations, agrees. "People are moving in to work for aquaculture," he says, driving through his town, pointing out a grocery store where locals who forget their wallets can still mark down what they owe at the register. Crewe, who has a day job with a telecom company and doubles as the town's deputy fire chief, says the town's paid tax rolls hover around 99 per cent, which would have been unthinkable in the years following the cod collapse. All that extra aquaculture money means the town could update its culverts, build new seniors' residences and add a new water fill-up station and fenced-in dog park.

> 'If we're going to address **CLIMATE CHANGE** in an aggressive and **serious way** on any kind of **reasonable timescale**, we need to massively confront the impacts of our **FOOD CHOICES**.'

In Cooke's Hermitage office, 34-year-old Lisa Bungay says her father, a longtime fisherman, and father-in-law, a fish buyer, were once deeply skeptical about the changes aquaculture have brought to the fiercely independent coast. "They were afraid that it would destroy what they had, and it did take a lot of convincing," she says, but they've slowly come around as the decades pass. "I got three younger siblings. None of us went fishing," she says. "I wouldn't be here if it wasn't for this industry."

Late last year, as Hurricane Fiona downgraded to a tropical storm over Nova Scotia, the storm battered sections of Newfoundland. It devastated the town of Port aux Basques, where waves ripped homes off foundations and swept one 73-year-old woman out to sea. In the following days, aquaculture operations throughout the region assessed the damage. It quickly became clear that large ocean facilities run by Cooke and Mowi had suffered limited harm, in part due to modern engineering standards. Instead, the region's hundreds of smaller operators and businesses seemed to have borne the catastrophic brunt of the storm. It's a strange and ongoing contradiction: large aquaculture companies know climate change is happening and can afford to invest in technology and additional gear that will secure their investments, as hundreds of diligent employees batten hatches, double-check lines and pens, and reinstall toughened materials and anchors on boats and gear. Small operators, including Docker and Nelson, simply scramble to keep up. And across every community, it's hard to predict whose home will be swept away next.

These concerns over a rapidly changing sea are echoed by third-generation Prince Edward Island mussel farmer Jacob Dockendorff, who has worked on his family's farm since his teens. He's particularly worried about how erratic the incoming storms have been in recent years. "You can't predict who's going to get hit," he says. Their sites, founded by his grandfather in the late 1970s, made it through Fiona relatively unscathed, but a nearby operation got pummelled. After the storm passed, insurable damage to buildings and infrastructure in P.E.I. totalled around $220 million as many islanders went without power for weeks.

Small players are in a constant state of playing catch-up, says Ramon Filgueira, associate professor in the marine affairs program at

From the TOP: Todd Perrin stands at the Quidi Vidi harbour, a stone's throw from his restaurant, Mallard Cottage; a Cooke fish hatchery employee passes a salmon parr from one bucket to another during a regular biweekly assessment of the fish; a Newfoundland-grown Merasheen Bay oyster at Mallard Cottage (LEFT) and mussels from Allen's Fisheries on the west coast of Newfoundland, in white wine, parsley and garlic (RIGHT) at Fawn in Halifax.


115

Clockwise from TOP: Cooke employee Craig Rose drives over to the company's site at Robin Hood Cove, N.L.; Cooke Aquaculture-farmed Atlantic salmon fillets in St. Alban's, N.L.; Sheldon George, Cooke Aquaculture's Newfoundland area manager and president of the Newfoundland Aquaculture Industry Association, sits down for a meal of Cooke's farmed salmon.

Dalhousie University. "It's impacting insurance, for the big companies that can afford insurance," he says. "Small producers are only thinking about surviving this year. They are so vulnerable." Bigger companies can make long-term plans and have the financial capacity to buy new infrastructure, while tax incentives and bailouts in every sector of the economy function primarily in large companies' favour, says Filgueira. Docker agrees and says Canada will continue to fall behind as long as governments focus on helping the region's largest, most-successful producers — using, for instance, emergency funds to compensate them for anemia-infected farmed salmon — instead of supporting smaller players working with more diverse species. Cooke, he points out, also got its start somewhere.

Despite opportunities to support aquaculture across the region, it frustrates some experts, including Thierry Chopin, a University of New Brunswick seaweed expert and marine biology professor, that Atlantic Canada's largest salmon companies don't seem particularly interested in following through. In the mid-2000s, Chopin pioneered a method of raising "greener" salmon, seaweeds and invertebrates — dubbed integrated multi-trophic aquaculture — that those salmon farming operations publicly championed as proof of their ongoing contributions to sustainability. The method combines the cultivation of species and re-creates a natural ecosystem as part of fish farming, using mussels to filter particulates in fish waste, seaweeds to improve water quality, and sea urchins to clean the ocean floor. Yet after decades of research and millions in federal and provincial funding — as well as producing salmon that earned an 11 per cent price premium over conventionally farmed salmon — most multi-trophic aquaculture projects were abandoned starting in 2017. That, according to Chopin, was when federal funding for the project ran out and the onus for the project fell back on industry partners, including Cooke. Lively, during our time together, said the shellfish business was simply not their specialty. Chopin counters that's not the best way forward for the region. "The companies say that unless they make enough money, they will not touch it. But we have to diversify," he says. "Cooke is good at salmon — great. But we need to have different companies who are all good at what they do." Without considering and caring for our ecosystems more widely, he says, it will be hard for salmon farms to grow sustainably, regardless of how much money is made. The costs, after all, must always be borne somewhere or by someone.

The result has been that customers and restaurateurs remain deeply confused, says chef Todd Perrin, owner of the renowned Mallard Cottage and Waterwest Kitchen in St. John's. "There's so much competing information out there that a guy like me doesn't know if it is good or bad," he says. "We don't serve farmed salmon, and I don't have a strong reason for it." In his restaurant, he proudly serves plates and bowlfuls of Newfoundland oysters and mussels, which, as filter feeders, actually help to clean the ocean. That he knows for sure.

CONSIDERING ALL the public debate, it's strangely fitting, says Dalhousie University food systems professor Peter Tyedmers, that the business of aquaculture itself could play a significant role in slowing the climatic changes that could fuel stronger Atlantic hurricanes. In a September 2022 study published in *Communications Earth & Environment*, he worked with a team that found farmed bivalves, including oysters, mussels and clams, as well as farmed Atlantic salmon, generate lower levels of greenhouse gas emissions and are nutritionally healthier than either pork or beef. "If we're going to address climate change in an aggressive and serious way on any kind of

ShanDaph oyster cages float in the distance (LEFT) as Hana Nelson and her children walk to the shore. Daphne Docker holds up a print of her dad Philip (RIGHT) pictured in the early days of ShanDaph Oysters.

reasonable timescale, we need to massively confront the impacts of our food choices," says Tyedmers. "One of the challenges is that this feels very personal to everybody, like 'I can't afford seafood,' or 'I don't like it,' or 'I have a shellfish allergy.'" He argues that it's "about operationalizing it not at an individual level but at a societal level. And it's about substitution, not supplementation. If you're going to a steakhouse for your anniversary dinner and also ordering the oysters and thinking you're virtuous, you've missed the point."

When compared with land farming, larger-scale aquaculture is startlingly young, and both Couturier and Chopin agree that's an opportunity to learn and do better. Chopin notes that although we have been improving agriculture for centuries, it is still not perfect. So, not surprisingly, aquaculture practices will also take time to evolve towards better environmental sustainability, economic stability and societal acceptability. The so-called Blue Economy needs, in fact, to take a greener approach, something Chopin refers to as the "turquoise economy" and "turquoise revolution." Tyedmers echos this view. For example, one way companies like Cooke could help fight climate change, he says, would be to immediately switch to feed with a lower carbon footprint. The feed might be more expensive, or the fish might not grow as quickly, or the company might make less money, but it could drastically lower each fish's carbon footprint. It's this kind of progressive thinking, he says, that will help us build a food system that can sustain planetary life. "I'm an environmental scholar, not randomly. It's connected to the same reason why we have one child," he says. "These are choices we made." A couple of years ago, looking for a patch of ocean to call their own, Tyedmers and his wife bought a cottage on Big Island, a peninsula in Pictou County, N.S., where they could buy ShanDaph oysters straight from the farm.

A few weeks after Hurricane Fiona hit, after Docker and Nelson got the okay to reopen their site for harvesting, the couple suited their kids up to gather a boxful, donning squeaking rubbery coveralls and tall boots for the wet work. Frigid winds whipped along the bay, heralding the year's first snow: unlike most land-based farming, theirs is a year-round operation, and oysters are harvested throughout the winter, even once the bay starts to freeze. Docker plunged his hands into the splashing water, pulling up a holding cage full of deep-cupped oysters ready for shucking. Now, with increasingly automated and worker-friendly systems in place — including a flotilla of cylindrical cages that can be mechanically pulled out of the water onto a customized barge for cleaning — he hopes to pass the farm to his kids, giving them a legacy of growing sustainable food like the utopia in Cousteau's vision. "*That's* the ecosystem I see that needs to grow," says Docker. "The shoreline that's changing every day, the houses going up, the farms shutting down — that system is so much more of a concern to me than just oysters and finfish." And when he and Nelson have finished recovering from Fiona, they'll start planning for the next big storm.